

What is claimed is:

1 1. A method for analyzing a sample of wafers, comprising the steps of:
2 (a) identifying F failure metrics that are applicable to at least one circuit pattern on each
3 wafer within the sample of wafers, where F is an integer;
4 (b) identifying Z spatial and/or reticle zones on each wafer, where Z is an integer;
5 (c) providing values for each of the F failure metrics, for each of the Z zones on each
6 wafer;
7 (d) defining a point for each respective wafer in an N-dimensional space, where $N=F*Z$,
8 and each point has coordinates corresponding to values of the F failure metrics in each of the
9 Z zones of the corresponding wafer; and
10 (e) clustering the sample of wafers into a plurality of clusters of wafers, so that the wafers
11 within each cluster are close to each other in the N-dimensional space, thereby identifying the
12 plurality of clusters of wafers from the sample of wafers so that within each individual
13 cluster, the wafers have a similar distribution of defects.

1 2. The method of claim 1, wherein step (c) includes extracting the values from failure bit
2 map data, multi-probe data or final die sort data collected from each wafer, using a die sort
3 tester.

1 3. The method of claim 1, wherein:
2 step (b) includes identifying Z reticle zones, corresponding to Z zones within a reticle
3 used to make each wafer,
4 each wafer has E reticle fields corresponding to E exposures of the wafer using the
5 reticle, and
6 step (c) includes providing, for each wafer, Z values for each failure metric, each of
7 the Z values representing a combined measure of the values of that failure metric for a given
8 one of the reticle zones across all E reticle fields of that wafer.

1 4. The method of claim 3, wherein the D reticle zones correspond to D die within each
2 reticle field.

1 5. The method of claim 1, wherein:

2 S spatial zones and R reticle zones are identified on each wafer, where R and S are
3 integers,

4 steps (c), (d) and (e) are performed with Z=S, using spatial data from the S spatial
5 zones, and

6 steps (c), (d) and (e) are performed with Z=R, using reticle data from the R reticle
7 zones.

1 6. The method of claim 1, further comprising after step (d), filtering the data to eliminate
2 noise.

1 7. The method of claim 1, further comprising after step (d),
2 performing a principle component analysis on the coordinates for each point to
3 identify a set of principle component scores;
4 identifying insignificant principal component scores; and
5 eliminating the insignificant principal component scores before step (e).

1 8. The method of claim 7, wherein step (e) includes:
2 initially assigning each wafer to a respectively different cluster;
3 determining a respective distance between each pair of the clusters in a principle
4 component space; and
5 recursively combining into a single cluster the pair of clusters that are separated by a
6 smallest distance in the principle component space.

1 9. The method of claim 7, wherein step (e) includes agglomerative hierarchical
2 clustering.

1 10. The method of claim 9, wherein a distance between a given two of the clusters is
2 defined as the greatest distance, in the N-dimensional space, between any two wafers in the
3 given two clusters, and the agglomerative hierarchical clustering includes combining wafers
4 of the clusters until the smallest distance between any two of the clusters exceeds a
5 predetermined threshold.

1 11. The method of claim 8, wherein the distance between a pair of clusters is defined as
2 the greatest distance between any two points corresponding to any of the wafers in the pair of
3 clusters.

1 12. The method of claim 1, wherein step (e) comprises:
2 (e1) initially assigning a subset of the wafers to one of the clusters;
3 (e2) determining a respective distance between the point corresponding to each of the
4 subset of wafers and a centroid of the one cluster;
5 (e3) calculating a first sum of the squared errors from the distances of step (e2);
6 (e4) calculating a second sum of the squared errors that is obtained from each of two
7 partitioned clusters to be formed by partitioning the one cluster, where the second sum of the
8 squared errors is based on the respective distance between each point and a centroid of the
9 respective partitioned cluster to which that point is to be assigned;
10 (e5) partitioning the one cluster into the two partitioned clusters, if the second sum of the
11 squared errors is significantly less than the first sum of the squared errors.

1 13. The method of claim 12, wherein step (e5) comprises partitioning the one cluster into
2 the two partitioned clusters, if one minus a ratio of the second sum of the squared errors
3 divided by the first sum of the squared errors exceeds a threshold value.

1 14. The method of claim 1, further comprising performing a commonality analysis to
2 identify one or more pieces of equipment responsible for a lot of wafers having a yield below
3 a desired yield.

1 15. The method of claim 14, wherein the commonality analysis includes a Monte Carlo
2 simulation.

1 16. The method of claim 14, wherein the commonality analysis includes analysis of
2 variance between lots of wafers.

AMENDED CLAIMS

[received by the International Bureau on 04 August 2004 (04.08.04);
claim 1 amended]

- 1 1. A method for analyzing a sample of wafers, comprising the steps of:
 - 2 (a) identifying F failure metrics that are applicable to at least one circuit pattern on each
 - 3 wafer within the sample of wafers, where F is an integer;
 - 4 (b) identifying Z spatial and/or reticle zones on each wafer, where Z is an integer;
 - 5 (c) providing values for each of the F failure metrics, for each of the Z zones on each
 - 6 wafer;
 - 7 (d) defining a point for each respective wafer in an N-dimensional space, where $N=F*Z$,
8 and each point has coordinates corresponding to values of the F failure metrics in each of the
9 Z zones of the corresponding wafer; and
 - 10 (e) clustering the sample of wafers into a plurality of clusters of wafers using a computer,
11 so that the wafers within each cluster are close to each other in the N-dimensional space,
12 thereby identifying the plurality of clusters of wafers from the sample of wafers so that within
13 each individual cluster, the wafers have a similar distribution of defects.
- 1 2. The method of claim 1, wherein step (c) includes extracting the values from failure bit
2 map data, multi-probe data or final die sort data collected from each wafer, using a die sort
3 tester.
- 1 3. The method of claim 1, wherein:
 - 2 step (b) includes identifying Z reticle zones, corresponding to Z zones within a reticle
3 used to make each wafer,
 - 4 each wafer has E reticle fields corresponding to E exposures of the wafer using the
5 reticle, and
 - 6 step (c) includes providing, for each wafer, Z values for each failure metric, each of
7 the Z values representing a combined measure of the values of that failure metric for a given
8 one of the reticle zones across all E reticle fields of that wafer.
- 1 4. The method of claim 3, wherein the D reticle zones correspond to D die within each
2 reticle field.
- 1 5. The method of claim 1, wherein: